

Referral Completion and Diagnostic Concordance of Obstetric Point-Of-Care Ultrasound Findings in Kenya

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Abstract

Background

Obstetric point-of-care ultrasound (OPOCUS) can enhance early detection of high-risk conditions such as multiple gestation, abnormal placentation, and malpresentation, facilitating timely referral and intervention. While adoption across low- and middle-income countries (LMICs) is growing, limited evidence exists on referral completion and diagnostic concordance between frontline OPOCUS findings and assessments at referral facilities. This study evaluated these outcomes within Kenya's primary healthcare system.

Methods

We conducted a prospective study of OPOCUS referral records from 115 Basic and Comprehensive Emergency Obstetric and Newborn Care (BEmONC and CEmONC) facilities across eight Kenyan counties over six months (February–July 2025). Referral completion was defined as confirmation of arrival at the receiving facility, while diagnostic concordance represented agreement between referring and receiving diagnoses.

Results

Of 565 recorded referrals, 471 (83%) were successfully traced and of these, 434 (92%) completed their referrals. Financial constraints accounted for most non-completions. Breech presentation (46%) and multiple gestations (24%) were the most common referral reasons. Overall diagnostic concordance was 75.3%, highest for multiple gestation (86.3%) and lowest for abnormal placental location (57%). There were significant statistical differences in concordance by obstetric parameters for both BEmONC ($p = 0.043$) and CEmONC facilities ($p = 0.031$). Marked county variation in referral completion was observed, with Turkana reporting the highest loss to follow-up (43%).

Conclusion

OPOCUS-supported referrals demonstrated strong completion and diagnostic agreement, underscoring its potential to strengthen maternal referral systems in resource-limited settings. Strengthened training and mentorship, documentation, and financial support mechanisms could further enhance accuracy and continuity of OPOCUS-driven referrals in LMICs.

BACKGROUND

Obstetric point-of-care ultrasound (OPOCUS) has emerged as a critical tool for early identification of high-risk obstetric conditions to facilitate timely decision-making and referral in primary antenatal care

(ANC) settings. Globally, the role of OPOCUS continues to expand as bedside imaging becomes increasingly valued for its ability to identify and initiate prompt management of complications responsible for maternal morbidity and mortality.¹ These developments align with World Health Organization recommendations for the integration of basic obstetric ultrasound within primary healthcare systems to enhance screening accuracy and improve maternal and newborn outcomes.^{2,3}

While access to comprehensive imaging remains limited in low-resource and rural settings,^{4,5} the incorporation of OPOCUS into routine ANC has been shown to support earlier detection of complications and increase early ANC attendance.⁶ Thus, expanding OPOCUS through task-shifting models has gained traction across many low- and middle-income countries (LMICs).⁷ Provider acceptance of OPOCUS is high; for example, 91% of Rwandan health professionals agreed that maternity care would improve if midwives were trained to perform basic ultrasound.^{8–10}

OPOCUS training programs across Africa show that mid-level providers can achieve high diagnostic agreement for essential obstetric indicators like fetal number, heart rate, and presentation.^{11,12} This accuracy is particularly strong when providers benefit from ongoing mentorship and quality assurance support, paving the way for reliable, evidence-based referrals.^{13–15} However, achieving consistent accuracy for more complex assessments, such as placental localization and fetal biometry, requires sustained supervised practice.^{16,17}

Importantly, achieving an accurate screening or diagnosis via OPOCUS is only the first step; the ultimate benefit of OPOCUS depends on mothers referred from lower-level facilities successfully reaching advanced care if warranted. Timely referral is integral to safe obstetric care; however, adherence and completion of referral varies widely across LMICs. Many women delay or do not complete referrals, often because of transport challenges, financial constraints, or household decision-making dynamics.^{18–20} Persistent fragmentation in coordination, documentation, and feedback mechanisms continues to undermine referral effectiveness associated with the introduction of OPOCUS in many settings. For example, a cluster randomized trial evaluating the impact of OPOCUS on a composite outcome of maternal mortality, maternal near-miss, stillbirth and neonatal mortality in five LMICs demonstrated the need to strengthen referral pathways when introducing OPOCUS to primary care systems.^{21,22} In other studies, health-system enablers such as clear documentation, structured referral forms, and supportive communication pathways introduced alongside OPOCUS were associated with improved referral adherence and completion.^{23,24}

In Kenya, OPOCUS has emerged as a promising strategy to improve early detection and fast-track timely, evidence-based ANC referrals from primary healthcare facilities.²⁵ The Kenyan Ministry of Health institutionalized national OPOCUS guidelines in 2024 to standardize training, strengthen referral pathways, and support its expansion of free access across all levels of care.²⁶ Despite this forward momentum, there are limited data on how often patients successfully complete their referrals and how well the initial frontline OPOCUS findings align with the final diagnosis at the receiving facility. Evaluating

these metrics is essential for determining the actual effectiveness of OPOCUS within primary healthcare systems. The objective of this study was therefore to evaluate referral completion among ANC clients referred based on an OPOCUS-identified concern, and the diagnostic concordance between the frontline OPOCUS findings and the assessments at the receiving facilities.

METHODS

Study Design

This prospective study analyzed OPOCUS referral records collected from 115 health facilities across eight counties in Kenya. The data were obtained from standardized referral tracer forms that had been in use for six months from February to July 2025 (hereafter, termed referral form, Appendix 1). This study was part of a larger evaluation of OPOCUS training and implementation in Kenya.^{27,28}

Study Setting

The study was conducted across 115 Basic and Comprehensive Emergency Obstetric and Newborn Care (BEmONC and CEmONC) facilities randomly sampled from the total 214 health facilities in the eight counties (Baringo, Kakamega, Kilifi, Kitui, Nakuru, Samburu, Taita Taveta, and Turkana) where OPOCUS training had been implemented. As previously described, nurse-midwives and clinical officers from 214 facilities received a five-day training conducted by the Global Ultrasound Institute between August and December 2022.²⁷ The training covered the identification of five high-risk maternal and fetal parameters: fetal presentation, placental location, amniotic fluid volume, fetal heart activity, and number of fetuses. Each trained provider was equipped with a Butterfly iQ+ probe and an iPad to facilitate OPOCUS use during routine antenatal and intrapartum care.

Sampling and Sample Size

From the 214 facilities equipped and trained in OPOCUS, a simple random sampling technique was used to select 115 facilities for inclusion in the study. At least 50% of the total facilities in each county were selected, resulting in 95 BEmONC and 20 CEmONC facilities as shown in Table 1.

Table 1

Distribution of facilities that were randomly sampled by district and type (BEmONC/CEmONC).

County	Total BEmONC	Sampled BEmONC	Total CEmONC	Sampled CEmONC	Total Sampled
Taita Taveta	9	6	4	2	8
Kitui	20	11	3	1	12
Samburu	8	4	4	2	6
Turkana	24	12	3	3	15
Kakamega	40	20	12	5	25
Kilifi	12	6	2	1	7
Baringo	14	8	4	2	10
Nakuru	58	28	6	4	32
Total	185	95	39	20	115

Data Collection and Variables

Prior to data collection, a standardized referral form was developed by the research team to trace client referrals. Health care providers were instructed to complete the form including reason for initial referral when making a referral to either a higher level facility or to another unit within the same facility. One copy was retained at the referral facility and a duplicate copy was given to the client for completion by the receiving clinician to capture clinical findings. Referral forms that were completed during the six-month study period (February to July 2024) were collected by trained research assistants. Research assistants were provided with airtime to contact the clients by phone. Clients were categorized as “traced” if they could be reached either by returning the completed referral form or via follow-up phone contact. Those who could not be reached were categorized as “lost to follow-up.” Among traced clients, those who confirmed visiting the receiving facility were further categorized as having “completed” the referral, otherwise clients were classified as did not complete referral.

The referral form captured demographic and obstetric details, patient contact information, and OPOCUS findings for the five key parameters assessed at the time of referral. It also recorded the reason for referral and a summary of feedback from the receiving facility. Those clients who presented with multiple pregnancy with one or both twins in breech presentations were classified as multiple pregnancy.

Statistical analysis

We used descriptive statistics to analyze the data. Because all study variables were categorical, we estimated overall proportions and stratified by BEmONC and CEmONC facilities. Concordance was

defined as an identical diagnosis for referral indication from both the referring and receiving facilities. Missing data were handled via complete-case analysis. To examine heterogeneity between proportions, we used the chi-squared test or Fisher's exact test when there were cell counts (count in any sub-category) of fewer than five. Statistical tests were two-sided and conducted at a 5% significance level; p-values < 0.05 were considered statistically significant. Analyses were performed using STATA version 17.

RESULTS

Referral traceability

We collected 565 referral forms across 115 health facilities of which 471 (83%) participants were traced (Fig. 1). Among the clients who were traced, 434 (92%) completed the referral. Almost three-quarters of the clients who completed referral 312 (72%) were from BEmONC facilities. Among the 37 (8%) clients who did not complete referral, the majority (95%) stated financial constraints as the main reason.

Contribution of referrals and loss to follow-up by county

The number of completed referrals varied across the eight counties, as did loss to follow-up (i.e., clients who were not able to be reached) (Fig. 2). Nakuru County had the highest number of referral forms initiated (173), followed by Kakamega County (114). However, Turkana County reported the highest percentage of clients lost to follow-up at 43%, despite having the lowest number of referrals made (23). Kitui County had the lowest proportion of clients who were lost to follow-up at 10%.

Reasons for referral across BEmONC and CEmONC facilities

Among all the referred cases, 435 (77%) were from BEmONC and 130 (23%) were from CEmONC facilities (Table 2). Among both types of facilities, the most common reason for referral was breech presentation 259 (45.8%) followed by multiple pregnancy 134 (23.7%). Table 2 shows that there was no statistically significant difference ($p = 0.350$) between the reasons for referral by type of facility.

Table 2
Reasons for referral across BEmONC and CEmONC facilities (n = 565).

Facility type			
Reason for referral	BEmONC	CEmONC	Total
	n (%*)	n (%*)	n (%*)
Breech presentation	195 (44.8)	64 (49.2)	259 (45.8)
Multiple pregnancy	111 (25.5)	23 (17.8)	134 (23.7)
Abnormal placenta location	50 (11.5)	19 (14.6)	69 (12.2)
Abnormal fetal heart rate	53 (12.2)	14 (10.8)	67 (11.9)
Abnormal amniotic fluid	26 (6.0)	10 (7.7)	36 (6.4)
Total	435	130	565
p-value	0.350		
*% are based on row total			

Diagnostic concordance among clients who completed referral

Among the 434 clients who completed referral across all facilities, the concordance between the initial OPOCUS diagnosis and the feedback from the receiving facility was 75.3% (327, Table 3). The degree of diagnostic concordance varied by the reason for referral which was statistically significant ($p = 0.001$). Multiple pregnancy showed the highest level of concordance with 86.3% agreement, whereas abnormal placental location exhibited the lowest concordance at 57% (Table 3).

Table 3
Diagnostic Concordance among Clients Who Completed Referral (n = 434)

Reason for Referral	Concordant	Non-concordant (n,%)	Total
	n (%*)	n (%*)	n (%*)
Multiple pregnancy	88 (86.3)	14 (13.7)	102 (100)
Abnormal fetal heart rate	47 (82.5)	10 (17.5)	57 (100)
Breech presentation	146 (73.0)	54 (27.0)	200 (100)
Abnormal amniotic fluid	18 (69)	8 (31)	26 (100)
Abnormal placenta location	28 (57.1)	21 (42.9)	49 (100)
Total	327 (75.3)	107 (24.7)	434 (100)
P value[!]	0.001		

* % are based on column total.

! p-value compares proportions of concordance with non-concordance across reasons for referral.

Diagnostic concordance separately within BEmONC and CEmONC facilities

There were significant differences in concordance by obstetric parameters separately within BEmONC (p = 0.043) and CEmONC facilities (p = 0.031, Table 4). Within BEmONC facilities, the highest concordance was observed for multiple pregnancy at 85% followed by abnormal fetal heart rate at 82%. Likewise, within CEmONC facilities the highest concordance was also observed for multiple pregnancy at 91% followed by abnormal fetal heart rate at 85%. Abnormal placental location assessment had the lowest level of concordance among both types of facilities, with 63% at BEmONC and 47% at CEmONC facilities (Table 4).

Table 4
Diagnostic Concordance separately within BEmONC (n = 312) and CEmONC (n = 122)

Diagnostic concordance separately within BEmONC (n = 312) and CEmONC (n = 122)				
Reason for referral	BEmONC n (%*)		CEmONC n (%*)	
	Concordance	Non-concordance	Concordance	Non-concordance
Multiple pregnancy	68 (85.0)	12 (15.0)	20 (90.9)	2 (8.1)
Abnormal fetal heart rate	36 (81.8)	8 (18.2)	11 (84.6)	2 (15.4)
Breech presentation	98 (71.0)	40 (29.0)	48 (77.4)	14 (22.6)
Abnormal amniotic fluid	12 (66.7)	6 (33.3)	6 (75.0)	2 (25.0)
Abnormal placenta location	20 (62.5)	12 (37.5)	8 (47.1)	9 (52.9)
Total	234 (75.0)	78 (25.0)	93 (76.2)	29 (23.8)
p-value	0.043**		0.031**	
* % are based on column total				

** p-value compares the same proportions but within BEmONC and CEmONC facilities, separately.

Discussion

This study examined referral completion and diagnostic concordance following OPOCUS supported referrals across BEmONC and CEmONC facilities in Kenya. The high referral completion rate observed among traced clients (92%) underscores OPOCUS's potential to strengthen screening diagnosis, initiation of referrals and continuity of care within lower-level facilities, where screening diagnostic resources are often limited. In the context of Kenya's commitment to maternal health, the high rate of referral completion found in this study supports the feasibility of the national strategy for integrating O-POCUS into primary care and is aligned with the goals of task-shifting and enhanced service delivery established in the National O-POCUS Implementation Framework.²⁶ Our findings on diagnostic concordance reinforce evidence that OPOCUS can empower frontline healthcare workers to make confident, evidence-based decisions, thereby facilitating timely referral.^{1,25} The results are particularly notable given the rural and remote settings of the project, where OPOCUS may bridge critical diagnostic gaps and accelerate frontline clinical response.⁶

The referral completion rate observed in this study, which needs to be interpreted with caution given the 17% loss to follow up, aligns with studies in similar LMIC settings that document the complexity of referral adherence.²⁹ In these contexts, such as the First Look Study, accurate identification of high-risk pregnancies did not translate to high referral completion due to socioeconomic and health-system barriers like lack of transport, limited facility capacity, and associated costs.^{19,29,30} In our study, the structured use of referral tracer forms may have helped enhance completion, consistent with existing

evidence that well-documented referral notes support more effective communication and follow-up between facilities.^{23,24,31} Nonetheless, financial constraints remained the predominant barrier to referral completion among individuals who did not complete referral. This finding is consistent with regional literature highlighting out-of-pocket costs as a significant determinant of delayed or incomplete referral.^{32,33} In Kenya, out-of-pocket payments continue to account for approximately 24% of current health expenditure,³⁴ suggesting that even when a diagnosis is accurately made at the primary level, downstream costs and transport logistics may impede referral completion. Thus, the national commitment to achieving Universal Health Coverage (UHC) through reforms like the establishment of the Social Health Authority (SHA) provides a critical framework for integrating OPOCUS scale-up and mitigating these cost-related barriers incomplete referral.⁴²

Marked inter-county variation was observed in both the volume of O-POCUS-initiated referrals and the proportion of clients lost to follow-up. Nakuru and Kakamega Counties contributed the highest number of referrals, a pattern consistent with higher service volumes and more established referral facilities in these counties. Previous O-POCUS studies have shown that facilities with higher patient volumes and stronger referral linkages are more likely to translate ultrasound-detected risk into referral action.^{15,23,24} In contrast, Turkana County, despite generating the lowest number of referrals, recorded the highest proportion of clients lost to follow-up (43%). This finding aligns with evidence from maternal health and O-POCUS implementation studies conducted in remote settings, where long distances to referral facilities, limited transport options and weak communication systems significantly hinder referral completion.^{18,19,20}

Our finding of moderate to high overall diagnostic concordance (75%) between referring and receiving facilities, with the strongest agreement for multiple gestation and fetal presentation, supports regional evidence. OPOCUS training initiatives across Africa consistently demonstrate that mid-level providers, especially with ongoing mentorship, achieve high diagnostic agreement with expert sonographers for core obstetric indicators.^{12–14} Implementation studies from Malawi, Uganda, and Kenya further corroborate this, showing that midwives and clinical officers maintain strong diagnostic performance following structured training and supportive supervision.^{35–37} These results confirm that trained non-specialist providers can reliably perform basic obstetric assessments using POCUS and align with WHO guidance supporting the task-sharing of these core competencies when standardized training is provided.^{3,38}

However, placental localization demonstrated the lowest diagnostic concordance (57%), reflecting its more technically demanding assessment. This pattern was observed in OPOCUS programs in other LMICs, where parameters required finer probe manipulation (such as precisely locating the placenta or detailed fetal biometry), which often show reduced accuracy unless providers received ongoing mentorship and practice.^{16,17,39} Frontline providers consistently emphasize the need for extended practical exposure and continued supervision to maintain competence in these advanced skills.^{40,41} Therefore, strengthening key support mechanisms such as structured mentorship, supportive

supervision, and long-term skills reinforcement, are critical to maintaining effective OPOCUS implementation.

Study strengths & limitations

Taken together, our study reinforces that OPOCUS programs have the potential to strengthen ANC, particularly when referral documentation and coordination are strengthened. To our knowledge, this is one of the few studies that used prospective data to report OPOCUS-related ANC referrals and successfully assessed concordance with high completion of referrals and limited lost to follow-up. Our study was embedded in a large-scale implementation project which collected data from multiple health facilities across levels of care in eight Kenyan counties, providing a realistic overview of how OPOCUS functions within actual service delivery settings. We utilized standardized referral forms to promote consistency in reporting and allow for a more comprehensive understanding of reasons for referral and diagnostic concordance.

There are several limitations to report. First, our study relied on provider completion of referral forms so we may not have captured all OPOCUS-related obstetric referrals (e.g., some referrals may have been initiated without a form). Second, our study did not capture gestational age at the time of referral or time between referral initiation and completion, so such conditions like breech presentation, abnormal fetal heart rate and placenta location may have changed between initiation and completion of referral. For example, fetal heart rate naturally fluctuates from minute to minute, and interventions initiated after the OPOCUS assessment and the time of the referral scan could contribute to variation. Conversely, fetal status may deteriorate over time, meaning fetal heart rate or even fetal viability can change between assessments. For fetal presentation, a fetus that appears breech during OPOCUS may convert to cephalic (or vice versa) by the time of the referral scan. Moreover, some discordance in placental location may stem from the difference between transabdominal OPOCUS and transvaginal scans conducted at referral facilities. These timing and methodological differences can therefore contribute to some observations of discordance. Third Lastly, concordance was determined by comparing referring provider findings with those reported by the receiving provider. However, in cases where clients were reached by telephone, particularly among women in difficult-to-reach counties, we relied on clients' self-report to assess concordance.

Conclusion

This study provides empirical evidence that when lower-level health providers are trained in OPOCUS and adequately supported, they achieve high diagnostic concordance with follow-up scans, which is vital for strengthening obstetric referral in LMIC settings. Our findings demonstrate that introducing strengthened referral documentation and follow-up mechanisms contributes to continuity of care. Moving beyond diagnosis and referral, we need to better understand the mechanisms to strengthen referral pathways, and track client referral outcomes in a sustained and nationwide scale that would ultimately improve maternal and neonatal survival.

Declarations

Ethics approval

Kenyatta University Ethical Review Committee (KUERC) provided the ethical approval for the study (number PKU/2563/1689-Appendix 2). Permission to carry out the study was also received from each of the County. Confidentiality and privacy were maintained throughout data collection and analysis by ensuring anonymous collection of data and only allowing access to data by the investigating team.

Consent for publication

Consent to participate and concept to publish were not applicable

Data availability

Data are available upon reasonable request to the corresponding author.

Competing interests

The authors declare that they have no competing interests

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This O-POCUS implementation initiative received financial support from the Gates Foundation (GF). Butterfly Network supplied and maintained the POCUS devices, and the Global Ultrasound Institute (GUSI) provided training. GF, Butterfly Network, and GUSI had no role in the study's design, implementation, or interpretation.

Author Contributions

The Kenyatta University (KU) team, in collaboration with colleagues from the University of California, San Francisco (UCSF) (DW, NS, RG), developed the study design and data collection instruments. GG, AW, JM, LO, SB, SG, GG, TN and GO were responsible for supervising the data extraction and took part in the data analysis. GG and AW prepared the initial manuscript draft. NS and DW contributed to the study design, data interpretation, and manuscript writing, while RG supported data synthesis, analysis and manuscript writing

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Figures

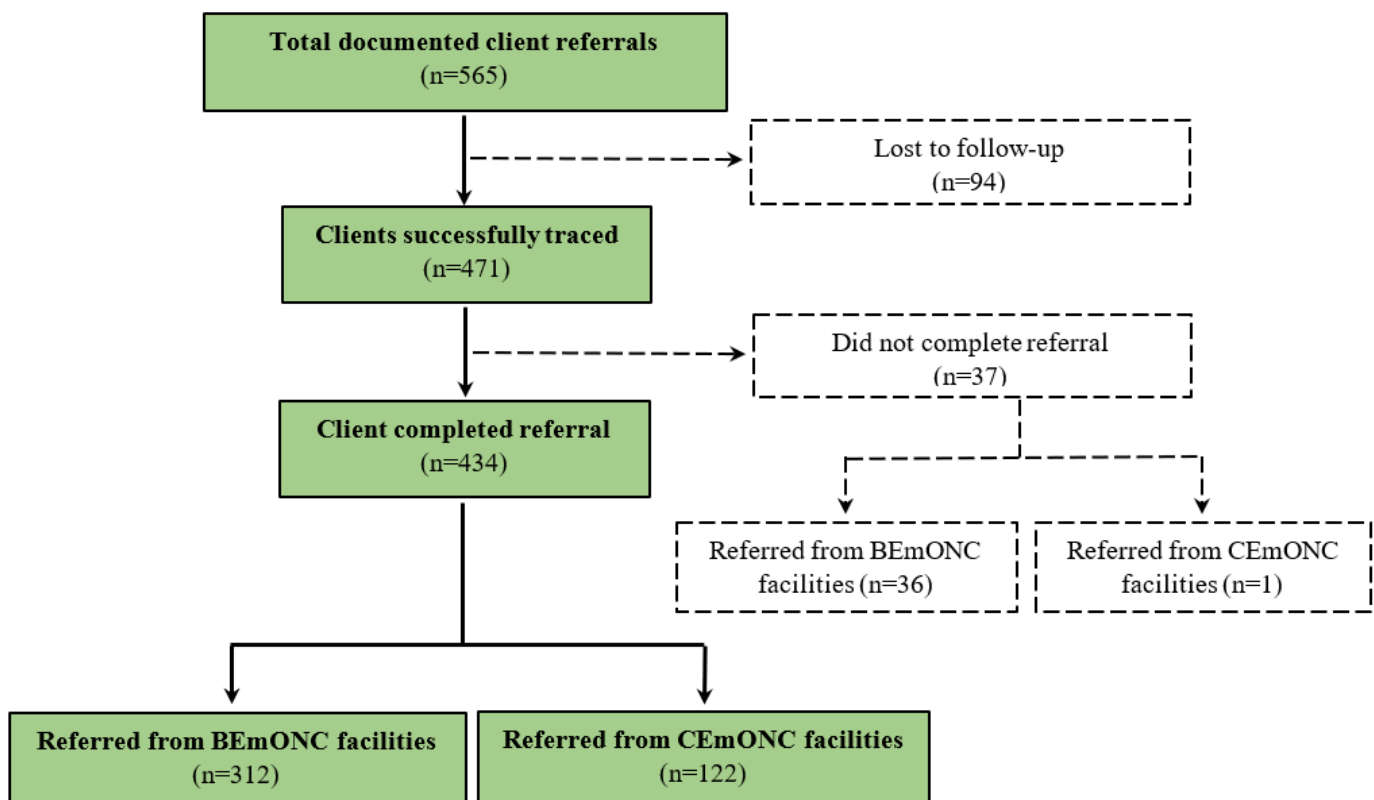


Figure 1

Flow chart of Referred Clients (n=565 from 115 facilities)

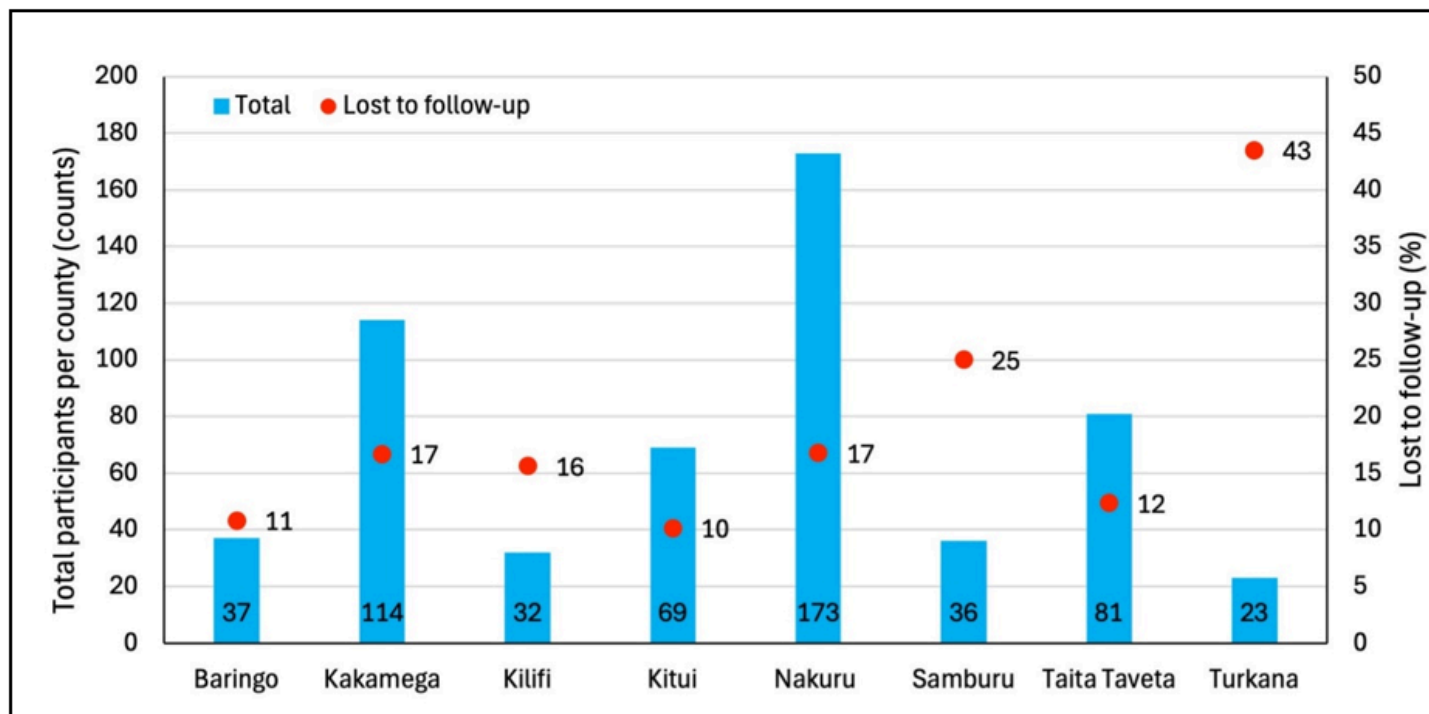


Figure 2

Number of completed referrals and proportion of loss to follow-up by county

Supplementary Files

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- [APPENDIX1REFERALFORM.pdf](#)
- [APPENDIX2ETHICALAPPROVAL.pdf](#)